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Physical Thinking and Social Problems

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THE PURPOSE OF THIS COMMUNICATION is to call the attention of physicists and other natural scientists to the fact that their scientific help is needed in basic research, which must precede the solution of many domestic and world-wide human problems. It is possible that a small number of carefully selected men with experience in the modern handling of natural science problems might, after intensive training in psychological and anthropological methods, make outstanding contributions in the field of social science.

In the last hundred years physics and chemistry have progressed rapidly while social adjustment has lagged behind. We social scientists simply do not yet have sufficient knowledge to cope with the social problems created by the wholesale application of the other sciences. We are shorthanded and overworked. There is a mass of basic research to be done, and yet we are pressed by real emergency to apply the little that we already know. We have not enough basic knowledge of the mechanics of individual aspiration and large-scale political interrelationships to plan the steps which must be taken to adjust human societies to the availability of atomic weapons.

Anthropology and the other sciences which deal with human behavior are just beginning to feel their way toward those concepts which will be nuclear to social science—concepts around which the developing science will crystallize as physics did around the concepts of mass, length, time, energy, etc. We are today in a Baconian or pre-Copernican stage, and yet our progress in the next few years might be very rapid. We have an enormous mass of collected descriptive material and poorly organized hypotheses, and this mass is certainly ready to assume new and more rewarding shapes the moment a few formative ideas are introduced into the system.

In spite of the dangers inherent in analogic thinking, it appears that many of these formative ideas are going to be akin to the sorts of idea which underlie much of modern physics. Man differs much from the entities of physical theory. He metabolizes, he reproduces himself, and, above all, he learns. And yet a strong case can be made for saying that even such protean entities as man and his communities could be profitably studied by scientists trained to elucidate the workings of multiple interdependent variables. Atoms, astronomical bodies, electric circuits, servomechanisms, and computing machines are the only structured entities for which most of the formal epistemological problems have been worked out, and it is therefore reasonable to challenge the experts in these fields to try their skill upon the most complex entities known to exist in our universe.

It is, of course, impossible to guarantee them success in these more complex fields—no scientist can ever be sure that he will solve his problem—but there are indications that the sort of thinking cultivated by modern physicists and mathematicians will be applicable. This statement may be illustrated by enumerating some of the problems which are basic to all social science and some of the limitations which the physicist has in common with the social observer:

(1) The physicist must include the observer and his instrument within the sphere of relevance of the observation. He knows that whatever characteristic (e.g. a velocity) he is measuring, the result can be regarded as "relatively objective" only after all relevant characteristics of the observer (his own position and velocity) have been systematically included. The field anthropologist similarly has learned to be aware of his own relevant characteristics (types of sensitivity, assertiveness, cultural conditioning, etc.) while he observes the corresponding characteristics of another people. He knows that his own character will systematically modify his perceptions and his interpretations and that his behavior may modify that of the people he is observing. (The case of the biologist is somewhat different. While he is studying the liver of a frog, it is not, in general, his own liver which will distort his observations. He is not subject to the systematic circumstance that his observation of any variable will always be a function of his own related characteristics.)

(2) The social scientist often has to deal with systems of reciprocal causation. In their incipient stages such systems may give simple autocatalytic curves, e.g. when the rate of propagation of a given political tenet is proportional to the number of converts. But such systems rapidly become more complicated. The unconverted may become aware of the heretics in their midst and may behave in such a way as to reduce the activity of the converts—or they may actually stimulate that activity. In any case, we have here a type of system which is familiar to the physicist. He can guess at the significance of any systematic change or oscillation in the resulting equilibrium, and he knows what questions should be asked about the time factors inherent in the process.[1]

(3) The social scientist must deal with the problem of "purpose." In the past, our analyses have too often have been phrased in either crudely causal or else crudely teleological terms. Too often we have postulated some sort of Maxwell's Demon (e.g. the "ego"), who should control the switchboard of the central nervous system, and then we have attempted to analyze this creature's character. Within the last few years it is mainly from the electronic physicists and mathematicians that we have obtained clues which will probably resolve the dilemma between crude causalism and teleology. It now appears that all self-correcting behavior and possibly all types of learning must be based on circular or "feed-back" systems such that effects of behavior at a given moment are fed back to modify the causal system which will shape behavior at a later moment (A. Rosenblueth, N. Wiener, and J. Bigelow, *Phil. Sci.*, 1943, **10**, 18). The whole of our teleological phrasings must now be revised, and new and more searching questions must be asked of all apparently adaptive behavior. Many of these questions will be of kinds which occur most easily to minds trained in modern physics.

(4) Recorded human behavior is significant only when the record includes the context. For example, stamping the foot can only be rated as "assertive" in a certain type of context. But we still lack any satisfactory system for classifying such contexts. A beginning has been made in this field by application of topological analysis (Kurt Lewin) to the temporal and spatial relations of preceding and expected events. It has further been argued that acquiring greater facility in learning in a particular type of context, *i.e.*, learning to learn, may be equated with learning to "expect" this type of context. This would imply that learning to learn (deuterolearning) is equivalent to the process of character formation. Further advances in the field of character formation and the classification of contexts could be expected from mathematicians and designers of computing machines, who handle problems of this order.

This series of examples could be multiplied almost indefinitely by referring to such matters as: conditioned reflexes, goal gradients, rote learning, interpretation of psychological tests, interpersonal relations, systems of value and conflicting incentives, systems of libidinal symbolism, and problems of social manipulation. In all of these fields the first steps have been taken toward logicomathematical analysis.

Enough has been said to indicate that the social sciences have plenty of work for physicists and other natural scientists to do. In conclusion, it is worth stressing that "the elimination of war as a means of settling international differences" is a project requiring basic and applied research ranging from learning experiments on rats, through comparative studies of simple communities, up to analysis of the most complex phenomena of contact between contrasting cultures.

[1] For analysis of systems of this kind, see G. Bateson's *Naven* (Cambridge Univ. Press, 1936, Chap. XIII) and L. F. Richardson's "Generalized foreign politics" (*Brit. J. psychol. Monogr.*, 1939). It is worth calling special attention to this paper in which a physicist has made important contributions to the social sciences.

Scanning Science—

At a recent meeting of the Board of Regents of the University of Michigan reductions were made in some of the salaries, and several instructors were dismissed. A resolution was adopted that where any department has two or more full professors, only the senior by date of appointment shall at any time receive a salary of more than $2,500. Law and medical professors, if they practice their respective professions, are to receive $2,000, and if they do not, $2,500. The psychological laboratory has been discontinued for one year.

—12 June 1896

Technical Papers

An Intestinal Antiseptic: 2-Sulfanilamido-5-Carboxythiazole[1]

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The synthesis of 2-sulfanilamido-5-carboxythiazole was first described in the literature by Backer and DeJonge (*1*), but no information concerning its chemical, pharmacological, or antibacterial properties was given. Like sulfaguanidine, succinylsulfathiazole, and phthalylsulfathiazole, 2-sulfanilamido-5-carboxythiazole is poorly absorbed from the gastrointestinal tract and possesses high antibacterial activity.

Chemistry. 2-sulfanilamido-5-carboxythiazole is a white, crystalline material and is stable in solid form. Samples over two years old have shown no deterioration. Analyses of the thoroughly dried compound give, within experimental limits, theoretical values for C, H, and N. When heated, the substance decomposes with effervescence between 200° and 220° C., depending on the rate of heating and the temperature of the bath when the melting-point tube is inserted. The compound is a fairly strong acid, liberating carbon dioxide when dissolved in sodium bicarbonate solution. Its solubility in water at room temperature (23°–25° C.) is approximately 40 mg. per cent. The pH of the saturated solution is 3.2. The solubilities in water of the mono and the disodium salts are greater than 30 per cent, the pH being 5.4 and 8.5, respectively. The sodium salt of the acetyl derivative has a solubility of approximately 8 per cent, and the pH of the saturated solution is 5.4.

The high solubility of the sodium salts of 2-sulfanilamido-5-carboxythiazole gives a chemical basis for the concentrations of the drug in solution that can be maintained in the intestinal tract. Any 2-sulfanilamido-5-carboxythiazole which is absorbed and which may be partially acetylated in the body will be freely soluble in the body fluids. This suggests strongly that there is little danger of deposition of crystals of the drug or its acetyl derivative in the kidneys or urinary tract, and the expectation has been borne out in all of the experimental work to date.

In vitro studies. The *in vitro* bacteriostatic activity of 2-sulfonilamido-5-carboxythiazole was tested against streptococcus, pneumococcus, and staphylococcus and against members of the colon-typhoid dysentery group, including *Vibrio cholerae*. Results are shown in Table 1. Data obtained with the more commonly known sulfonamides are included.

TABLE 1

Comparison of Bacteriostatic Activity of 2-Sulfanilamido-5-carboxythiazole With Other Sulfonamides*

	Lowest concentration (mg. per cent) at which stasis was exhibited at 72 hours					
	SA	SP	ST	SD	SG	SC
Streptococcus (C203)	10.0	5.0	2.5	10.0	10.0	10.0
Pneumococcus (SVI)	2.5	1.25	0.3	2.5	1.25	2.5
Staphylococcus aureus (Barlow)	1280		2.5	5.0		> 160
Escherichia coli	20.0	5.0	0.6	0.6	10.0	5.0
Aerobacter aerogenes	80.0	5.0	2.5	5.0	160	10.0
Salmonella enteritidis	> 80.0	10.0	2.5	2.5	> 80.0	20.0
Shigella dysenteriae (Shiga)	2.5	0.15	0.15	0.15	2.5	0.6
Shigella sonnei	20.0	1.25	0.3	0.6	10.0	2.5
Shigella paradysenteriae (Flexner I)	40.0	0.6	0.6	0.6	20.0	0.6
Shigella paradysenteriae (Flexner II)	40.0	2.5	0.6	1.25	20.0	2.5
Shigella paradysenteriae (Flexner III)	2.5	2.5	0.3	0.3	10.0	2.5
Vibrio cholerae	10.0	1.25	0.15	0.6	20.0	5.0

* SA = Sulfanilamide, SP = sulfapyridine, ST = sulfathiazole, SD = sulfadiazine, SG = sulfaguanidine, SC = 2-sulfanilamido-5-carboxythiazole.

It was found that 2-sulfanilamido-5-carboxythiazole possessed as much activity against streptococcus as did sulfanilamide, sulfadiazine, and sulfaguanidine. Against pneumococcus, it again showed comparable activity with sulfanilamide and sulfadiazine, being only slightly less active than sulfapyridine and sulfaguanidine. It proved more active against staphylococcus than sulfanilamide, while sulfathiazole was the most active of the compounds tested. It showed appreciable activity against the enteric group of organisms, being in general more active than sulfanilamide and sulfaguanidine, and in some instances equal to sulfapyridine, sulfathiazole, and sulfadiazine.

[1] The writer acknowledges the assistance of E. R. Bockstahler, H. E. Faith, H. J. Florestano, J. F. Kennedy, and H. E. Martin, Pitman-Moore Company, Indianapolis, Indiana.

In vivo studies. Acute toxicity of 2-sulfanilamido-5-carboxythiazole in mice gave the following results: by oral administration, LD_{50}, 8.0 grams/kg.; intraperitoneal, LD_{50}, 5.0–6.0 grams/kg.; subcutaneous, LD_{50}, 8.0 grams/kg. The chronic toxicity studied in mice, rabbits, and dogs was found to be much less than that of the readily absorbed sulfonamides and sulfaguanidine and comparable with succinylsulfathiazole.

Studies on the absorption following oral administration were carried out in mice, rabbits, dogs, and men. Blood levels obtained in all species were low (e.g. in man given 0.25 grams/kg./day for five days, the maximum blood level was less than 1.0 mg. per cent).

Absorption and excretion studies in man revealed that from 3 to 11 per cent of the 2-sulfanilamido-5-carboxythiazole administered orally was excreted in the urine, the average being 6.1 per cent.

The effect of the compound on reducing the number of coli in the feces of dogs and man was very striking. Comparison of the data with those of Poth, *et al.* (*3*) indicates that 2-sulfanilamido-5-carboxythiazole reduces the number of coli more rapidly and at a lower dose level than either succinylsulfathiazole or phthalylsulfathiazole. In a study of more than 200 patients on succinylsulfathiazole therapy, Poth and his co-workers found that 38 per cent showed less than 1,000 *E. coli*/gram of wet feces within three days of treatment, and that 79 per cent had less than this number within five days of treatment and 93 per cent within seven days. Poth explained that the remaining 7 per cent failed to respond to therapy within seven days because of some condition interfering with the action of the drug. The dosage used by Poth consisted of 0.25 gram/kg. of succinylsulfathiazole as an initial dose, followed in four hours by 0.25 gram/kg. daily, divided in six equal amounts and administered at four-hour intervals. Although the number of subjects on 2-sulfanilamido-5-carboxythiazole was small, it is worthy to note that the most refractory case studied had less than 1,000 coli/gram of feces within 48 hours of treatment at the same dosage employed by Poth. One subject, given one-half the dosage, showed less than 10 coli/gram of feces within 48 hours of treatment. With two subjects on 0.25 gram/kg. daily, omitting the initial dose of 0.25 gram/kg., a count of less than 1,000 coli/gram of feces was obtained within the first 24 hours of therapy. At the end of the second day, both counts were below 10 coli/gram of feces. Thus, in each of the four instances where 2-sulfanilamido-5-carboxythiazole was administered in doses either equal to or decidedly less than that employed by Poth for succinylsulfathiazole, coli counts of less than 1,000/gram of wet feces resulted within two days of treatment.

In an independent clinical study of the compound, Harris and Finland (*2*) report findings that are in general agreement with these. They used the drug in treating cases of bacillary dysentery and state that, in the amounts given, it is poorly absorbed and that, as far as could be determined it is nontoxic. They found the drug to be effective in the cases of dysentery studied and state that it may deserve a place with the other drugs used in enteric infections and in bowel surgery.

Extensive clinical trials at a number of medical centers are now in progress which will establish the value of 2-sulfanilamido-5-carboxythiazole relative to that of other drugs used for intestinal antisepsis.

References

1. BACKER, H. J., and DEJONGE, J. *Rec. trav. chim.*, 1942, **61**, 463.
2. HARRIS, H. W., and FINLAND, M. *Proc. Soc. exp. Biol. Med.*, 1945, **58**, 116.
3. POTH, E. J. *J. Amer. med. Ass.*, 1942, **120**, 265; POTH, E. J., and KNOTTS, F. L. *Arch. Surg.*, 1942, **44**, 208; POTH, E. J., KNOTTS, F. L., LEE, J. T., and INUI, F. *Arch. Surg.*, 1942, **44**, 187; POTH, E. J., and ROSS, C. A. *Texas Rep. Biol. Med.*, 1943, **1**, 345; POTH, E. J., and ROSS, C. A. *J. lab. clin. Med.*, 1944, **29**, 785.

Pectoral Girdles *vs.* Hyobranchia in the Snake Genera *Liotyphlops* and *Anomalepis*

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The Serpentes have always been considered to differ from all other reptiles in having lost the pectoral girdle completely. Recently, however, Dunn and Tihen (*1*) reported the discovery of a shoulder girdle in a primitive burrowing snake, *Liotyphlops albirostris.* This report seems to warrant further investigation before the interpretation of this structure can be accepted or rejected.

The specimens studied are, in part, the same as those used by Dunn and Tihen. Two specimens of *Liotyphlops albirostris* stained with alizarin red and cleared in glycerine were obtained from Dr. J. A. Tihen. Mr. K. P. Schmidt provided a stained specimen of *Anomalepis dentatus.* Finally, one specimen of *Anomalepis aspinosus,* used for gross dissection, was loaned by Mr. A. Loveridge. The writer is greatly indebted to these authorities for providing the necessary material.

Anomalepis, which is considered a close relative of *Liotyphlops,* possesses the same structure that Dunn and Tihen described in *Liotyphlops.* It is here considered valid, therefore, to apply findings in the

former genus to *Liotyphlops* and to the problem originally posed by it.

Dunn and Tihen present evidence to show that (1) a structure at the anterior end of the trachea is the hyobranchial apparatus and that (2) a more posterior element is a vestigial pectoral girdle. The present author believes that there is other, almost incontrovertible evidence that an alternative explanation suggested but not adopted by Dunn and Tihen is the proper one: that the anterior element is the cricoid cartilage of the larynx and the posterior element the hyobranchial apparatus.

The posterior element of Dunn and Tihen was found by gross dissection in a specimen of *Anomalepis aspinosus* measuring 178.4 mm. in total length. The anterior portion of the structure is extremely superficial, while the posterior parts are found imbedded progressively deeper in muscle. The structure is thread-like and shaped roughly like an M whose legs have been bent back upon themselves. It is situated 3.6 mm. posterior to the tracheal opening. The anterior horizontal part is 1 mm. broad and depressed 2 mm. medially. On either side it curves posteriorly to form two somewhat divergent posterior processes. These extend posteriorly for 1.3 mm., at which level they are 1.9 mm. apart, and then recurve sharply to assume an anterior course parallel to the posterior processes and separated from them by .2 mm. The anterior course can be seen for only .6 mm. in this specimen, although in the stained specimen it can be seen to extend as far forward as the level of the central depression in the horizontal portion. The extreme thinness of the apparatus probably accounts for the difficulty of demonstration by gross dissection.

M. geniohyoideus, M. sternohyoideus, M. omohyoideus, and M. hyoglossus are the muscles which Gnanamuthu (*3*) describes as having attachments to the ophidian hyobranchial apparatus. M. geniohyoideus has its origin on the mandible and its insertion on a median raphe, the basihyal and the anterior borders of the thyrohyals (= posterior cornua of the hyobranchium). M. sternohyoideus and M. omohyoideus have cutaneous origins, and have insertions on the thyrohyals. M. hyoglossus has its origin on the hind end of the posterior cornua of the hyoid and passes forward to form the greater part of the musculature of the tongue.

In *Anomalepis aspinosus* all the above muscles are found attached to the structures mentioned. M. geniohyoideus originates on the mandible and inserts on the anterior and anterolateral borders of the horizontal portion and posterior processes of the structure. M. sternohyoideus inserts on the posterior border of the horizontal portion and on the median surface of the posterior processes. It extends caudad to a cutaneous origin. The two remaining muscles—M. omohyoideus and M. hyoglossus—are attached to the portion of the posterior process where it recurves sharply and extends anteriorly. M. omohyoideus inserts on the posterior margin of the bend and runs posterolaterally to its cutaneous origin. M. hyoglossus has its origin on the anterior margin of the bend and runs anteromedially; its right and left divisions converge anteriorly and join each other at the level of the horizontal portion of this element. At this level the two divisions of the M. hyoglossus are firmly bound together by connective tissue and form, with the M. genioglossus, the bulk of the tongue musculature.

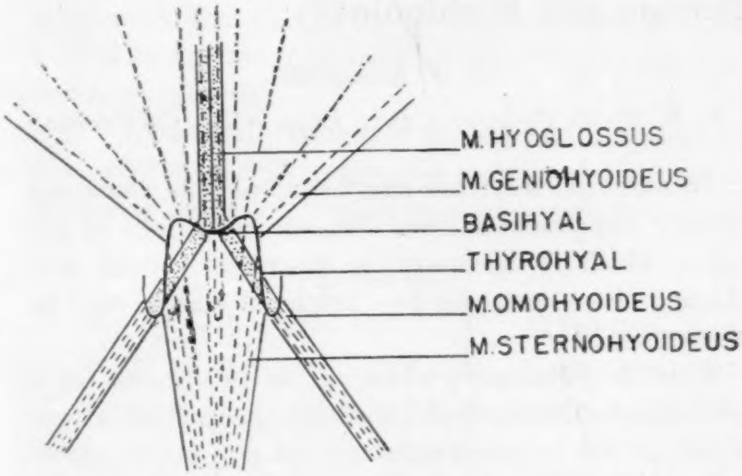

FIG. 1. Hyobranchium and associated muscles of *Anomalepis aspinosus*.

The laryngeal apparatus of serpents consists of dorsal paired arytenoid cartilages which are narrowly continuous posteriorly with the cricoid cartilage. Edgeworth (*2*) cites as exceptions the genera *Boa* and *Python* in which, according to him, the arytenoids articulate with the cricoid instead of being fused with it. The cricoid cartilage is a single structure having a striking $\wedge$-shaped anterior extension on the ventral surface and a more posterior and smaller $\wedge$ or Ω configuration on the dorsal surface of the larynx. The cricoid cartilage extends posteriorly and is fused on either side with a variable number of tracheal rings.

Although the arytenoid cartilages cannot be discerned in the stained specimens of *Liotyphlops albirostris,* the cricoid cartilage is distinct. It is the anterior element which Dunn and Tihen interpreted as the hyobranchial apparatus. This cricoid cartilage is in the usual position and has the structure typical of all ophidians. It should be regarded as such.

The combined existence of hyoidean muscular attachments on the posterior element and the demonstration of typical cricoid form of the anterior element indicate that the concept of a pectoral girdle in *Liotyphlops* and *Anomalepis,* intriguing though it is, should be discarded. The structure incorrectly inter-

preted as a girdle should rather be regarded as a hyobranchial apparatus. It is different from any other hyobranchium ever recorded in snakes, but not different enough to cause concern regarding its identity. A further discussion of its significance is reserved for a later paper.

References

1. DUNN, E. R., and TIHEN, J. E. *J. Morphol.*, 1944, **74**, 2, 287–295, Pl. 1.
2. EDGEWORTH, F. H. *The cranial muscles of vertebrates.* London: Cambridge Univ. Press, 1935. Pp. x + 493. (Illustrated.)
3. GNANAMUTHU, C. P. *Proc. zool. Soc. Lond.*, (*B*), 1937, **707**, 1–63, figs.

Interrelations Between Choline, Betaine, and Methionine[1]

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In nutrition there are many examples in which one dietary component reduces the required intake of another which is necessary to maintain normal life. Among these examples two principal classes may be distinguished:

Class 1. Substances which act as precursors for a physiologically required substance, permitting a synthesis of the required substance to any extent necessary. A few examples of this class are: (a) the several vitamin A-active carotenoids which are precursors for vitamin A; (b) methionine as a precursor of cystine; and (c) dimethylethanolamine in replacing dietary choline.

Class 2. Substances which may assume or diminish certain, but not all, functions of a required nutrient and which are not related to the required nutrient as a precursor or complete substitute. Examples of this class are: (a) the well-known effect of fat in reducing the requirement for thiamine; (b) the similar effect of Ca and P on vitamin D, especially in the fowl; and (c) the value of dietary cystine in reducing the necessary methionine level.

These two classes do not include other types of substances which affect the stability, absorption, transport, and utilization of nutrients and for which there already are specific and descriptive designations such as antioxidants and pro-oxidants, poisons, carriers, enzymes, etc. In the present discussion the term "sparing action" is reserved for examples as in Class 2, to the first of which it was applied quite some years ago (*7*).

In examples of Class 2, the "sparing" substance is able either to (1) partially reduce the need for, or (2) provide some, but not all, of the biological functions of the "spared" compound. It is characteristic of these examples, in contrast to those of Class 1, that the replacement does not continue to be effective as the intake of the spared compound decreases, but often becomes sharply limited. In other words, a significant quantity of the spared compound must be present in order that a sparing action may become evident.

In dogs, fat may spare no more than approximately two-thirds of the thiamine requirement (*4*). In promoting calcification, Ca and P are interchangeable with vitamin D over a considerable range, yet all the vitamin D cannot be replaced by Ca and P without incurring additional symptoms of vitamin D deficiency (*8, 19*). Steps in the biological synthesis of cystine from methionine and other precursors have been demonstrated and reviewed in considerable detail (*6*). The reversal of this process does not take place, however, since a definite minimal level of methionine, which cannot be reduced further by surplus amounts of cystine, is needed both by rats (*24*) and by chicks (*2*).

In the rat, choline synthesis from betaine or methionine proceeds readily, *i.e.* the known symptoms of choline deficiency may be relieved by using sufficient of these substitutes (*5, 10, 21*). On the other hand, in the chick, choline synthesis is extremely limited. Methionine does not replace choline in chicks (*9, 11, 13, 20*) or in turkeys (*12*) for preventing perosis when the deficiency of choline is *severe*. A similar statement may be made for betaine in the case of *severe* choline deficiency (*1, 13, 15, 16*). Synthesis of choline in the chick may evidently take place from dimethylaminoethanol, which promotes growth and prevents perosis, but the total synthesis fails somewhere in the stages leading to this compound (*14*).

Chicks grew very slowly on a purified diet which involved a combined severe choline and partial methionine deficiency (*1, 9*). Upon the addition of methionine, the chicks made improved gains which reached a plateau at about two-thirds normal rate. It is noteworthy that the effect of methionine was definitely limited and, with respect to the choline requirement, probably consisted of the provision of methylating capacity but no extensive synthesis of choline. In the presence of ample choline and cystine and a partial deficiency of methionine in the basal diet, improved but limited growth rate was again observed. The evidence suggested that the methionine-sparing actions of cystine and choline were additive under the experimental conditions.

With other sources of labile methyl (methionine and betaine) present in the diet not more than 0.02 per cent choline was needed to support a two-thirds optimal rate of gain. Any choline synthesis which may take place in the chick is probably less than this figure,

[1] Condensed from an address delivered at AAAS-Gibson Island Research Conferences, 1945.

or not more than 10 or 20 per cent of total requirements. In a recent study, evidence has been produced that the choline requirement of the chick for any given rate of growth on a homocystine-supplemented diet was approximately two-thirds replaceable by betaine (*17*). For optimal gains, chicks required close to 0.06 per cent betaine-irreplaceable choline and 0.14 per cent replaceable choline in the diet. This figure of 0.06 per cent irreplaceable choline is in agreement with an approximate figure of 0.05 per cent found in the presence of surplus methionine or methionine plus betaine (*1*).

Arsenocholine is an analogue of choline which does not methylate homocystine in the rat (*18*) or chick (*3*); however, it is effective in lipotropic activity and phospholipid synthesis (*22, 23*) and will promote growth and prevent choline-deficiency perosis in the chick (*1, 15*). Arsenocholine apparently replaces choline for all the functions mentioned except for that of methylation.

The sparing action of arsenocholine on choline in chicks was very distinct, although definitely limited. It is significant that while the choline-sparing effects of betaine and of methionine were not additive to each other, being of the same nature, *i.e.* methylating capacity, the effect of either one was qualitatively additive to that of arsenocholine (*1*).

A chick diet which is only mildly deficient in choline (0.08 per cent) and approximately adequate in methionine and cystine may be improved for growth and perosis prevention by the addition of betaine or methionine (*16*). In such a diet the effect of methionine and betaine additions may be explained by assuming that both supplements assisted the choline in a methylating capacity, thereby augmenting the supply of choline available for growth and perosis prevention. In other diets in which the choline level (0.03 per cent) was less than the level of essential choline, very little, if any, improvement was noted from methionine or betaine additions. In every case, choline additions elicited strong responses (*16*).

A choline deficiency, like that of many other nutrients, is physiologically a *multiple* deficiency. This is due to the highly varied functions of choline, such as tissue and lipid synthesis, lipotropic action, methylating action, and perosis prevention. Viewed from this standpoint of a multiple deficiency, it is more comprehensible how a compound which can provide only a part of the several functions of choline may still exert a sparing action by releasing residual choline for its other functions.

The results reviewed above furnish illustrations of the principles of the sparing action, which may be briefly summarized as follows:

(1) A sparing action takes place when a nonprecursor compound furnishes or reduces a portion, but not all, of the physiological functions of a required nutrient.

(2) While operating in the relief of one of these deficiencies, the effect of the sparing substance becomes limited or may even be nullified if additional deficiencies come into play.

(3) If several substances can be added which relieve additional deficiencies, the individual sparing actions may be cumulative, at least in a qualitative way.

References

1. Almquist, H. J., and Grau, C. R. *J. Nutrition*, 1944, **27**, 263.
2. Almquist, H. J., and Grau, C. R. *J. Nutrition*, 1945, **29**, 219.
3. Almquist, H. J., and Jukes, T. H. *Proc. Soc. exp. Biol. Med.*, 1942, **51**, 243.
4. Arnold, A. *J. biol. Chem.*, 1939, [illegible]
5. DuVigneaud, V., Chandler, J. P., Moyer, A. [illegible], and Keppel, D. M. *J. biol. Chem.*, 1939, **131**, 57.
6. DuVigneaud, V., Kilmer, G. W., Rachele, J. R., and Cohn, M. *J. biol. Chem.*, 1944, **155**, 645.
7. Evans, H. M., and Lepkovsky, S. *Science*, 1928, **68**, 298.
8. Fritz, J. C., Hooper, J. H., and Moore, H. P. *Poultry Sci.*, 1945, **24**, 324.
9. Grau, C. R., and Almquist, H. J. *J. Nutrition*, 1943, **26**, 631.
10. Griffith, W. H. *J. Nutrition*, 1941, **22**, 239.
11. Jukes, T. H. *J. biol. Chem.*, 1940, **134**, 789.
12. Jukes, T. H. *J. Nutrition*, 1941, **20**, 251.
13. Jukes, T. H. *J. Nutrition*, 1941, **22**, 315.
14. Jukes, T. H., and Oleson, J. J. *J. biol. Chem.*, 1945, **157**, 419.
15. Jukes, T. H., and Welch, A. D. *J. biol. Chem.*, 1942, **146**, 19.
16. McGinnis, J., Norris, L. C., and Heuser, G. F. *Proc. Soc. exp. Biol. Med.*, 1944, **56**, 197.
17. McKittrick, D. S. Univ. California, 1945. (Unpublished.)
18. Moyer, A. W., and DuVigneaud, V. *J. biol. Chem.*, 1942, **143**, 373.
19. Nowotarski, J. S., and Bird, H. R. *Poultry Sci.*, 1943, **22**, 72.
20. Record, P. R., and Bethke, R. M. *Poultry Sci.*, 1942, **21**, 271.
21. Stetten, DeWitt, Jr. *J. biol. Chem.*, 1941, **138**, 437.
22. Welch, A. D. *J. biol. Chem.*, 1941, **137**, 173.
23. Welch, A. D., and Landau, R. L. *J. biol. Chem.*, 1942, **144**, 581.
24. Womack, M., and Rose, W. C. *J. biol. Chem.*, 1941, **141**, 375.

Scanning Science—

Lord Kelvin's jubilee as professor of natural philosophy in the University of Glasgow was celebrated 15 and 16 June at Glasgow. On the sixteenth Lord Kelvin addressed a group of delegates from England and foreign university bodies.

—12 June 1896

Science Legislation

Forum

This forum is arranged from material selected by the editorial staff from testimony given on 28 and 29 May before the Subcommittee on Public Health of the House of Representatives Interstate and Foreign Commerce Committee.

Science has been endeavoring to keep up to date with the current developments in the Congress related to science legislation. The equivalent of almost three regular issues has been devoted to this subject since 1 January.

Readers of *Science* were informed for the first time on 7 June that a bill proposing a National Science Foundation had been introduced into the House on 15 May and hearings before a subcommittee had been held on 28 and 29 May. Since this new bill, H.R. 6448, was based on the older Senate Magnuson Bill and not on the compromise Kilgore-Magnuson Bill, S. 1850, Watson Davis was caused to remark that the new bill seems to divide again those scientists who favor some kind of Federal support for research.

In the same issue Howard A. Meyerhoff pointed out that the introduction of the new bill was a definite threat to the establishment of a National Science Foundation during this session of Congress and implied that it might be necessary to go through the whole process of compromising the opposing factions all over again.

In order that our readers may be better informed with regard to the issues, the views of Dr. Homer Smith, speaking for the Committee Supporting the Bush report, and the Secretary of Commerce, Henry A. Wallace, are presented here, together with a statement from Dr. Meyerhoff outlining his position as executive secretary of the American Association for the Advancement of Science. The statements of Dr. Smith and Secretary Wallace are somewhat abbreviated. Dr. Meyerhoff's statement was written expressly for *Science*.

Why H.R. 6448 Is the Better Bill

Homer W. Smith
New York University

. . . Despite the preponderant testimony from scientists and those experienced in scientific affairs in favor of the Magnuson Bill, this bill remained in administrative disfavor. At the conclusion of the [November] hearings it was clear that the essential principles for the preservation of the freedom of science, so strongly urged by all of Dr. Bush's committees, were in danger of being completely submerged in favor of political control. There was strong opposition to scientists having anything more than a nominal voice in determining the policies of the Foundation. It was presumed that the top scientists of the country would give generously of their time to act on an advisory committee which had neither authority nor responsibility. It was clear, in short, that the philosophy of the Foundation was to be one appropriate to war mobilization and government direction, and not one appropriate to the peacetime development of science by experienced civilian scientists.

On 14 November a number of scientists met under the chairmanship of President Isaiah Bowman, of The Johns Hopkins University, to discuss the progress of this legislation. At that time it appeared that the essential principles for the preservation of the freedom of science and the protection of the National

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Why S. 1850 Is the Better Bill

Henry A. Wallace
Secretary of Commerce

. . . In my opinion S. 1850 combines the best features of S. 1285 and S. 1297 as well as a number of additional desirable provisions which grow out of the expert testimony presented at the hearings. S. 1850 is in accordance with the President's recommendations on science legislation; H.R. 6448 is in conflict with those recommendations on several important points.

I believe that the following provisions of H.R. 6448 are particularly undesirable:

(1) The bill provides that the powers and duties of the National Science Foundation shall be exercised by a part-time administrative board of nine members appointed by the President with the advice and consent of the Senate. This is substantially the same administrative arrangement as in the original Magnuson Bill in the Senate, S. 1285. A slight compromise has been made, however, by providing that the Director of the Foundation shall be appointed by the President from nomination by the Board, in place of the original provision for a Director appointed by the Board. Since all powers of the Foundation rest in the Board, this compromise is more apparent than real. As I stated in my testimony on the Senate Bills, I am strongly opposed in principle to turning over public functions and responsibilities, and especially the power to allocate public funds, to a part-time board of private citizens. I am in complete agreement with the President's position

(*Continued on page 725.*)

Why I Am Biased in Favor of S. 1850

Howard A. Meyerhoff

Executive Secretary, AAAS, Washington, D. C.

For several months I have been reporting news on science legislation in the pages of *Science,* and I have ventured to add current editorial opinions which were prompted by the news. Some of the opinions expressed were sharp, and it was anticipated that they would evoke protests. They did. The volume, if not the vigor, of the protests has been small, and they usually accuse the writer of bias. This is the reason for choosing the title of this article, which is partly a reply to those critics, but which, it is hoped, will also add something new to the issues under debate.

In early October 1945, several hundred scientists returned questionnaires circulated through the AAAS Council. Over 90 per cent believed that a National Science Foundation should be created. Officially, as executive secretary of the Association, I thereupon attempted to convert this belief into legislation. Several elementary principles had to serve as guides: 1) such legislation must meet the high standards of the scientific professions *and be acceptable to a decided majority of scientists;* 2) it had to be acceptable to the Senate committees sponsoring the legislation and at least to a bare majority in Congress; 3) it had to be acceptable to the Executive Branch of the Government or face a veto.

These principles are so self-evident that they should not need stating, but they have been violated by those who clung so long and so obstinately to S. 1285; by those who believe that S. 1777 is the ideal bill; and by those who currently insist that H.R. 6448 embodies everything scientists should want. It would make no difference whether any of these bills is better than S. 1850 from some special point of view—the great majority of scientists do not think so. Support of any of these other bills at this time violates the first principle; and further, as Senator Saltonstall emphatically stated in an address delivered in Washington on 12 June, it creates the impression of dissension among scientists, and dissension is the precursor of legislative defeat.

I participated in most of the conferences which preceded the formulation of S. 1720 and the ultimate adoption of S. 1850. On the administrative side S. 1850 is the only bill which meets with the approval of experienced legislators.

I witnessed the agreement of the chairman of the Committee Supporting the Bush Report that S. 1850 meets the basic administrative requirements of that group.

I heard the Commissioner of Patents assert that the bill involves no patent reform or changes, and industrialists should agree that the systematization of patent procedure in government departments and bureaus for which S. 1850 provides is desirable.

I was present on the two occasions when the patent provisions were altered to give full protection to the rights and interests of manufacturers and industrial laboratories.

I witnessed, with regret and protest, acceptance of limitations on social science, imposed by the Committee Supporting the Bush Report, although two-thirds of the scientists who participated in the AAAS poll favored inclusion of the social sciences.

There is thus embodied in S. 1850 the most careful consideration of every controversial point and the most effective and acceptable solution of each and every issue. Two hundred thirty-two members of the AAAS Council, which includes representatives of most of the 196 organizations affiliated with the AAAS, believe that this is so; only 10 are sufficiently fearful of political control of science to have voted against support of S. 1850. So long as this proportion wants a National Science Foundation, I am strongly biased in favor of the only bill which has given thought to every issue and alone makes an earnest effort to meet minority needs and objections—S. 1850.

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as expressed in a letter from the Director of the Bureau of the Budget to Dr. Vannevar Bush that in order to make the Foundation "effectively responsible to the President and the Congress it should be headed by a director appointed by the President, who should have full administrative responsibility for the operation of the foundation and its several divisions."

(2) H.R. 6448 does not provide for a Division of Social Sciences, but permits the Board to establish such a division. Nor does the bill provide specifically for scholarships and fellowships in the social sciences. In my opinion the inclusion of the social sciences is too important and fundamental a question to be left to the discretion of the Board and is a proper subject for determination by the Congress. I urge that a Division of Social Sciences be incorporated in the legislation itself.

Both branches of science contribute to national defense and to the general welfare and are, therefore, deserving of Federal support. Moreover, it is generally recognized that the social sciences, which are relatively young, have in many respects not reached the high stage of develop-

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A United Front for S. 1850

Robert Chambers
Union of Biological Sciences

New developments are appearing which go far toward endangering enactment of S. 1850. And it is this bill which combines those provisions of the original Kilgore and Magnuson Bills meeting the approval of the great majority of scientists in this country. The AAAS Council at the St. Louis meeting voted 223 to 10 in support of the bill. Moreover, the Committee Supporting the Bush Report published a statement (*Science*, 1946, **103**, 558), as an appeal to Congress on behalf of the 5,000 scientists who had signed the letter to the President favoring the Magnuson Bill, saying that the Committee endorsed the combined Kilgore-Magnuson Bill, S. 1850. This appeal, with the 5,000 endorsements, was mailed to the President and Congress on 23 April 1946. S. 1850 was approved by a majority of the Senate Committee on Military Affairs and has been on the Senate calendar since early April of this year.

Of the two disturbing factors which have recently appeared, one is the "Minority Views of the Senate Committee on Military Affairs," presented by Mr. Bridges and signed by Senators Austin, Bridges, Wilson, Revercomb, and Hart. This document (Calendar No. 1153, Report 1136—Pt. 2) can be obtained from the Government Printing Office. It attacks several of the provisions in the constitution of S. 1850. It claims that the state responsibility of education and learning will be brought under the domination of the Federal Government, and that the proposed administrator will be a veritable Czar of Science. It is fearful of the strain entailed on the already dangerously overbalanced budget of the Nation, citing as an example of climbing costs that Federal research in 1940 amounted to $70,000,000 and by 1944 was $700,000,000! The absurd criticisms make one wonder regarding the intelligence of the writer of the "Minority Views."

The other disturbing factor is the appearance of a new bill, H.R. 6448 (also obtainable from the Government Printing Office), sponsored by Representative Wilbur Mills. This is actually a revision of the original Magnuson Bill calling for a Board appointed by the President assisted, I understand, by the National Academy of Sciences. In a report which appeared in the *New York Times*, 29 May, the statement is made that the House Bill 6448 is expected to supersede S. 1850. H.R. 6448 attempts to reduce governmental supervision to a minimum; it seriously restricts provisions for a Division of the Social Sciences; it eliminates mandatory geographical distribution of funds to state-supported and land grant colleges, whereas S. 1850 provides for a more thorough distribution of funds throughout the country than we have at present; it eliminates provisions affecting the Government's patent policy which, in S. 1850, has been approved of by those competent to do so. In brief, H.R. 6448 again presents us with a sort of bill already objected to by many who were critical of the original Magnuson Bill. On the other hand, it eliminates those features which were deplored by the Committee Supporting the Bush Report in their recent statement purporting to be an appeal to Congress to enact S. 1850.

H.R. 6448 again opens up the controversy between scientists who had taken sides for and against the Kilgore and Magnuson Bills—a controversy which we had hoped had been settled by a combined bill acceptable to the greatest possible majority. A still worse feature is that hearings were held in Washington on 28 May at which Isaiah Bowman, chairman of the Committee Supporting the Bush Report, and others of the same Committee presented testimonies in favor of the bill. The impression given was that their testimonies constitute the opinion of scientists at large. Why was the Committee appointed by the Council of the AAAS at St. Louis in March not brought into the testimony? The testimony apparently did not include those who were active in revising the Kilgore Bill.

From the 3 May statement made by the Committee Supporting the Bush Report, we read:

> We believe that the creation of a National Science Foundation to support fundamental scientific research and the education of scientists is of the utmost importance for the health, security, and welfare of the nation. . . . Believing the matter to be of great urgency . . . we endorse this bill and appeal now to the Congress as a whole to create a National Science Foundation by the enactment of S. 1850. . . .

Now a few influential members of this Committee appear to be in favor of something which will hamper the very stand the Committee took in the statement just quoted! Senators and Congressmen may introduce difficulties concerning S. 1850, but, at least, the scientists should be unified in the support of a single bill. The one bill which has the widest support is S. 1850.

News and Notes

A discussion of national science legislation, under the auspices of the Washington Association of Scientists, was held in the Commerce Department Auditorium in Washington, D. C., on the evening of 12 June, Phillip N. Powers presiding. Featured on the program were addresses by Leverett Saltonstall, Senator from Massachusetts; Roy K. Marshall, director of the Fels Planetarium, Franklin Institute; and Howard A. Meyerhoff, executive secretary of the American Association for the Advancement of Science. All of the participants spoke in favor of S. 1850, pointing out that this bill represents a reasonable compromise in the matter of creating a National Science Foundation, and urging that scientists present a united front in order that such legislation might be passed at the earliest possible time.

E. Harold Hinman has just returned to the Tennessee Valley Authority, Health and Safety Department, as chief of the Division of Malaria Control. For the past four years he was Chief of Party of the Institute of Inter-American Affairs, Health and Sanitation Division, the first year in El Salvador and the last three years in Mexico. Prior to his departure from Mexico he received the Eduardo Liceaga medal from the Government of Mexico for eminent contributions to public health.

M. Tchou-Su, Institute de Biologie, 393 Route Ferguson, Shanghai, China, is badly in need of reprints, especially in the field of experimental embryology. He was associated with E. Bataillon, at the University of Montpellier, France, for several years and has published extensively.

Hood Worthington, who has been on assignment for the last three years at the Hanford Engineer Works, which the Du Pont Company formerly operated for the Government, has been appointed assistant director of the recently organized engineering research section, Rayon Technical Division, of Du Pont.

Ch. Joyeux, French parasitologist at the Institut de Médecine et de Pharmacie Coloniales, Université d'Aix-Marseille, France, writes as follows:

> It is no longer possible for me to continue my research work. My laboratories were badly damaged during the course of the war, and the great increase in prices prevents further experimental work. I have retired, leaving to younger men the task of reconstructing the laboratory. I shall devote the remaining years of my active life to making scientific expeditions to different countries.

W. Malcolm Reid (Monmouth College)

Alfred Métraux, formerly with the Bureau of American Ethnology, Smithsonian Institution, has been appointed social affairs officer of the United Nations, a newly created office under the direction of Mr. Laugier, Undersecretary of UN.

Col. George C. Crom, Jr., after more than five and one-half years active duty with the AAF, is on terminal leave. Col. Crom's military service was highlighted by his contributions to the development of a wide range of aircraft electrical equipment. He is also credited by Wright Field officials with a major role in the development of 400-cycle power systems for aircraft. His service included tours of duty in Alaska and England in connection with cold-weather tests on turbosupercharger regulators. Col. Crom will continue to serve in a civilian capacity at Wright Field as a research consultant in the Engineering Division's Equipment Laboratory.

Sir D'Arcy Wentworth Thompson, of St. Andrews University, Scotland, was awarded a Daniel Giraud Elliot medal for his book *On growth and form* on 23 April by the National Academy of Sciences.

S. Ansbacher, formerly scientific director of the International Vitamin Corporation and scientific consultant of the American Home Products Corporation, has been appointed director of nutritional research of the Schenley Research Division.

E. G. Stanley Baker, released from service with the AAF as an aviation physiologist, has been appointed assistant professor in the Department of Biology at the Catholic University of America, effective 1 October 1946.

A. Cyril Callister, associate clinical professor of surgery, University of Utah School of Medicine, recently delivered a series of illustrated lectures at the Cardiological Institute of Mexico City, under the auspices of the National University at Mexico City, and at the University of Southern California Medical School. Dr. Callister's subject was: "The Use of Tube Grafts in the Treatment of Deep Complications of Burns."

Announcements

The Empire Scientific Conference of the Royal Society, London, opened 17 June and will extend to 8 July. The Conference opened in London, moves to Cambridge on 22 June, to Oxford on 1 July, and back to London for two closing days. A general description of the program follows:

17 June Opening Ceremony.

18 June General Scientific Organization; papers from Canada, New Zealand, and the Colonies.

19 June General Scientific Organization; papers from Australia, South Africa, and India.

20 June Methods of improving the interchange of scientists throughout the Empire.

22 June Natural products of the Empire and the chemical industries that are or might bebased on them.

24 June Agricultural science in the Empire; Mineral resources of the Empire.

25 June Measures to secure greater uniformity in physical standards of measurement and the use of units, terms, and symbols; Collection and interchange of scientific records and experimental material, including the safeguards that will have to be taken to minimize the risk involved in the distribution of plants, seeds, and animals.

27 June A scientific information service (for scientists).

28 June The etiology and control of infectious and transmissible diseases, particularly those which are insect-borne.

1 July Physiological and psychological factors affecting human life and work under tropical conditions and in industry; Modern methods of mapping and exploration by air, including the use of radio technique in ordnance survey.

3 July The science of nutrition.

4 July Land utilization and conservation, including forestry, soil erosion, irrigation, etc.

6 July Empire cooperation in the scientific field, with existing and projected international organizations.

8 July Dissemination of scientific news to the public generally.

Why H. R. 6448 Is the Better Bill

(*Continued from page 724.*)

Science Foundation from political control or interference were in serious jeopardy. The immediate outcome of this meeting was the creation of the Committee Supporting the Bush Report. The first action of this Committee was to address an open letter (*Science*, 1945, **102**, 545) to President Truman, emphasizing in a constructive manner the principles emphasized in the Bush Report. This letter, dated 24 November, and signed by 43 scientists, was released with the prior consent of the President. It placed upon the President's desk an appeal to restore the initiative in science legislation to his own hands; it announced clear-cut principles for the information of legislators who must assess this legislation; and lastly, it served to inform scientists throughout the country that all was not well with the legislation and to acquaint them with the major issues involved.

This letter was subsequently opened to general endorsement and over 5,000 scientists of all ranks and from all branches of science added their names to the original endorsements and supported the position taken by the Committee. Shortly thereafter President Truman replied to Dr. Bowman in terms which made it clear that he favored the provisions of the Kilgore rather than the Magnuson Bill.

Since that time numerous conferences have been held among representatives of Dr. Bush's office, the Committee Supporting the Bush Report, and Senators Kilgore and Magnuson or members of their staffs. Conferences have also been held with other Senators directly or indirectly concerned with pending science legislation. In view of the indications in Washington, it appeared that the best hope for early enactment of science legislation lay in modifying the last draft of the Kilgore Bill, S. 1720, along such lines as would make it acceptable to scientists generally.

Largely in consequence of a continued exchange of views, a new joint bill, S. 1850, was framed and sponsored by Senators Kilgore, Magnuson, Johnson, Pepper, Fulbright, Saltonstall, Thomas, and Ferguson, and introduced in the Senate on 21 February. This bill was reported to the floor by the Senate Military Affairs Committee on 19 March by a vote of 6 to 2, the opposing Senators contesting the patent sections, the inclusion of the social sciences, and the mandatory allocation of funds to land grant and tax-supported institutions. The opponents of this last provision call it with some warrant "the land grant pork barrel." Its effect is to throw substantial sums of money toward tax-supported institutions, some of which, as judged by graduate work, give evidence of little or no interest in or capacity for research, and to deprive privately supported institutions which have research merit of an equivalent amount. Every person who has considered this legislation is in favor not only of equitable geographical distribution but of using Federal funds to build up research in promising institutions where research is not well developed. But the automatic allocation of funds, even though their expenditure is not required, does not, in the opinion of many, seem the wisest method of accomplishing this end. Allocation should be left flexible and in the hands of the National Science Board.

Although S. 1850 follows the general pattern of "in-line" organization, with considerable power vested in a single administrator, the Foundation proposed therein is such that the best interests of science appear to be protected and scientists assured of reasonable authority and responsibility in policy-making and administrative decisions.

Consequently, a statement (*Science,* 1946, **103**, 558) ncerning S. 1850 from the Committee Supporting e Bush Report, signed by 34 scientists who could ickly be reached, was circulated under date of 16 pril to the 5,000-odd scientists who had signed or dorsed our letter to the President. In this statement it was pointed out that S. 1850 was a compromise ll; that many scientists doubted the wisdom of (a) cluding the social sciences in this legislation, (b) the ovisions affecting the Government's patent policy, d (c) the arrangement for mandatory geographic stribution of funds to land grant colleges and taxpported institutions; but that despite these undesirable features we regarded protracted delay or ilure to enact this legislation as far more prejudicial o the public interest than the inclusion of the provisions objected to; and on these grounds we endorsed he bill and appealed to Congress as a whole to create National Science Foundation by the enactment of S. 1850 before the end of the present session.

Briefly then, our position is that the Committee Supporting the Bush Report has from 14 November onwards endeavored to remove such undesirable features in the Kilgore Bill, S. 1720, as is possible and o amend it along other favorable lines. Throughout hese negotiations we were committed, if feasible amendments were effected, to support this bill if and when it came to a vote in the Congress.

Only a few members of our Committee have seen the present bill, H.R. 6448. However, I have read it carefully and note that it conforms with the Magnuson Bill and incorporates certain constructive and acceptable changes indicated during the Senate hearings and in subsequent consultations. It complies with the position taken by the Committee Supporting the Bush Report, in their letter to President Truman of 24 November, in the following respects: the Director is subordinate in authority to the National Science Board; the social sciences, although not excluded, receive limited support until such a time as the Board may see fit to create a Division of Social Sciences; patent provisions do not modify the Government's patent policies in such a way as to discourage private and government-supported research; and there is no provision for the arbitrary geographic distribution of funds.

It is not clear to me whether or not it is possible for the Congress to create a National Science Foundation with an administrative pattern which does not meet with the approval of the President and of the Bureau of the Budget; whether it is possible for the Congress, against the wishes of the Administration, to create a National Science Foundation devoted solely to the interests of the natural sciences; or whether it is possible for the Congress to create this Foundation without disturbing revisions of our patent laws. On the assumption that these things may be possible, it is my opinion that H.R. 6448 is superior to S. 1850, and I believe that the great majority of the 5,000 scientists who endorsed the Magnuson Bill will give it their wholehearted support.

It is imperative, however, that legislation incorporating one or the other of these bills, or the best features of both, should be enacted at this session, since the creation of a National Science Foundation to support fundamental scientific research and the training of scientists is, as we have said, of the utmost importance for the health, security, and welfare of the Nation.

Why S. 1850 Is the Better Bill

(*Continued from page 725.*)

ment of many of the physical and natural sciences. The present lack of balance in the development of the physical and social sciences is one of the important reasons for including provision for the social sciences in the Science bill. The great advances in physical and chemical research and the advent of atomic energy may well mean that we are on the verge of a new industrial revolution and profound social and economic changes. New and challenging problems will confront the social sciences, the solution of which may greatly affect the welfare of the peoples of the world. I believe that you will find that the most eminent and the most thoughtful of the physical scientists in this country believe that the encouragement and development of the social sciences is even more important than further progress in the physical sciences. The further development of the social sciences may well determine whether the new and terrible forces which man has discovered through the natural and physical sciences become man's servant for enhancing his welfare or the terrible instruments for his destruction. I am in complete agreement with the President's recommendation that Federal financial support be extended to the social as well as to the natural sciences.

Before leaving this subject, I should like to refer to the objections which have been raised to the inclusion of the social sciences in this legislation. Much of that objection has come from persons who are neither natural nor social scientists and have little first-hand experience with the methods and the accomplishments of social science. As Secretary of Agriculture, Vice-President, and Secretary of Commerce, I have had a good opportunity to work with many natural and social scientists. *The sweeping assertion that social science is not science at all is nonsense.* The methods of science are equally applicable to natural and social phenomena, and the standards in many fields of social science research are just as rigid and exacting as those in the natural sciences. The claim that social science is concerned with vague and impractical problems can be made only by those unfamiliar with its accomplishments. Every member of this committee knows from

experience with legislation that intelligent solutions to the problems presented to the Congress are impossible without statistical and other factual information developed by social scientists. The same situation exists in private business: increasing numbers of social scientists are being employed in industry and commerce and long-range plans as well as the day-to-day operations of our largest business enterprises are being based on the studies of social scientists. To dismiss the social sciences with a wave of the hand is to discard one of the most important tools for obtaining improved and urgently needed basic knowledge.

(3) H.R. 6448 provides that the disposition of patent rights to inventions and discoveries resulting from research financed by the Foundation shall be left to the discretion of the Board. However, as a guide to the Board, there is additional language outlining the following general policy: (1) inventions in the field of basic science resulting from research *completely* financed by the Foundation would in general be dedicated to the public; and (2) with respect to inventions in the field of applied science to which the research contractor has also made some independent contribution, the United States would receive only a right to use the invention without cost for governmental purposes.

These provisions give the Foundation positive encouragement and direction to allow private patents on discoveries resulting from research financed by public funds. I am unalterably opposed to these provisions. They perpetuate and give the approval of the Congress to the past and present unsound policies followed by some government agencies. The private research contractors of the Foundation will not be small and independent business enterprises; they will be the big corporations with large and well equipped laboratories which already have a tremendous advantage over their small competitors by virtue of the scientific and technical improvements which they alone can afford to develop and to patent. The provisions of H.R. 6448 will provide government support and financing to the research and patents of big business and lead to further industrial concentration, lessened competition and the stifling of small business and new enterprises. The President in his message to the Congress on 6 September 1945, clearly outlined the only sound public policy on this matter. That policy is to require dedication of all patents resulting from research contracts to the public, with only such narrow and strictly defined exceptions as may be necessary to secure the placing of a few important contracts in exceptional cases where the only qualified contractor will not accept a contract without some provision for private patents on his previous research.

(4) H.R. 6448 makes no specific provision for letting research contracts to other government agencies; yet such agencies—for example, the National Bureau of Standards—may frequently be highly qualified and well equipped to carry on research in a number of important scientific fields. I believe that it would be very desirable to provide explicity in this legislation as an indication of Congressional policy that other Federal agencies may receive funds from the Foundation and that such funds shall be in addition to, and not take the place of, other money specifically appropriated to such agencies.

(5) No provision is made in H.R. 6448 for any coordination of the increasing amount of scientific research conducted directly by the Federal Government or financed by Federal funds. On the basis of experience with several important scientific bureaus in the Department of Commerce, such as the National Bureau of Standards, the Weather Bureau, and the Coast and Geodetic Survey, I am convinced that such coordination should constitute one of the principal and most useful functions of a properly organized National Science Foundation. This was also one of the President's principal recommendations in his message to the Congress on 6 September 1945. There is some danger in the period immediately ahead that American science will not suffer from lack of financial support but from misdirected and conflicting support which will dissipate the energies of our limited number of first-class scientists. There is already the sharpest kind of competition for the services of qualified scientists by the universities, by industry, by the Army and Navy, by the Manhattan Project, and by other government agencies. We are also faced with a great deficit in scientific personnel due to the interruption of the training of young scientists during the war. It will take careful coordination of our scientific effort to make sure that we reserve sufficient qualified scientific personnel for teaching purposes to make up this deficit. The Federal Government cannot and should not determine the scientific programs of private industry and the universities, but it can at least coordinate its own scientific program. I believe, therefore, that any National Science Foundation bill must have a provision for an interdepartmental advisory committee consisting of representatives of the principal government agencies concerned with scientific research. Such a committee would advise and consult with the Foundation and make recommendations to the Foundation and to the President for the coordination of Federal and Federally-financed research programs.

There are several additional provisions of H.R. 6448 which I believe to be undesirable and contrary to sound public policy; and with your permission I should like to submit a supplementary statement on those additional matters for the record within a few days. The bill was introduced and called to the attention of the Department so recently that we have not had sufficient time to consider carefully the legal effects of some of its detailed provisions.

In closing I should like to repeat that while I support wholeheartedly the general objectives of the legislation which you are considering, I cannot endorse H.R. 6448. Many of the specific provisions of this bill, and especially those which I have discussed above, will not foster the progress of free scientific inquiry. On the contrary, they will lead to an increasing monopolization of science by a small clique and operate to the detriment of small and independent business in this country.

In the Laboratory

Modification of the Ergograph

F. W. Kinard and C. D. Coleman
Department of Physiology, Medical College of the State of South Carolina, Charleston

The ergograph is used in physiological and psychological laboratories where it is desired that muscle work be measured and recorded. These instruments are costly and are usually designed to record upon a single type of kymograph or at one height. The ergograph to be described is relatively simple to construct, is durable, and can be adjusted readily to record at any height upon various types of kymographs.

An essential feature of the instrument (Fig. 1) is a metal base on one end of which is a wrist support, consisting of a curved wooden block with adjustable metal plates to contact the wrist, and a hand grip. On the other end of the base is a rigid vertical rod. The rod is arranged with a pulley proximal to the hand, another at the top, and two on the distal side. The ring into which the finger is fitted is connected to one end of a stainless steel, flexible, twisted cable

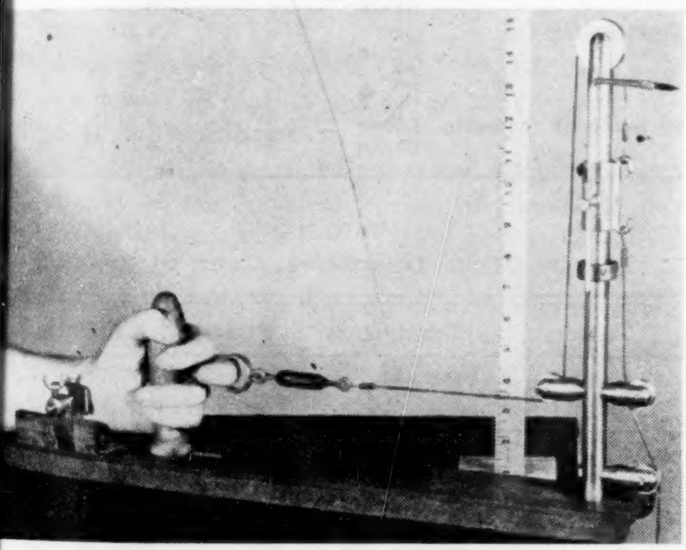

Fig. 1

by means of a turnbuckle. The cable then extends beneath the proximal and over the uppermost pulleys to end in a loop which is slipped onto a hook on the upper part of the sliding sleeve. This sleeve is constructed with a key or pin which slides in a groove in the rod, permitting free movement up and down but preventing rotation. The sleeve carries on its surface a post with a knurled setscrew which tightens against the stylus to permit vertical and lateral adjustments. The end of the stylus is slotted and has a piece of flexible X-ray film fastened in place by means of a sliding collar. The looped end of a second stainless steel cable extends from the lower hook on the sliding sleeve and across two pulleys, ending in a hook on which the desired weight is hung. A collar is fixed at the desired height on the vertical rod by a setscrew and serves to arrest the sliding sleeve.

Operation: The wrist is laid in the support and the hand support gripped. The hand grip is then fixed at a comfortable position, the wrist support adjusted, and one finger placed in the ring. The desired weight is suspended from the hook on the end of the second cable. The stylus is adjusted vertically or laterally until its X-ray film tip touches the flat surface of the kymograph. Exercise is then performed at the rate which is desired, and a kymographic record is obtained of a definite weight being lifted through a measured distance.

Use of Wetting Agents in Histological Fixatives

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The quality of a tissue fixative is thought to be enhanced not only by a careful balance of its component ingredients but also by its speed of penetration (*2*). In the past, rapid penetration has been achieved by the addition of such substances as urea, acetic acid, and certain wetting agents (*1*).

To test the validity of the hypothesis that speed of penetration improves the quality of a fixative, a series of carefully prepared, well-known fixing solutions were employed, and to these, three wetting agents were added.

Methods

Nine widely used fixatives were selected as follows: Zenker's, Carnoy's, Helly's, Bouin's, Allen's, Gilson's, Orth's, and Vandegrift's fluids (*3*), and 10 per cent formalin. All of the above solutions were modified in three ways by the addition of the following aliphatic substances: Tergitol-7; Tergitol-4; and Tergitol-08 (*4*) in the ratio of 3 drops to 100 cc. of fixative. Because of the known characteristics of these three agents in decreasing surface tension, it was hoped that the speed of penetration would be increased.

Because of their histological differences, homogeneous nature, large size, and ready availability, the tissues selected were sheep cerebrums and human liver. Pieces of tissue one inch square were cut and placed

in 250 cc. of the aforementioned fixatives for a period of 24 hours. They were then sectioned, and the average depth of penetration of each fixative was measured grossly. Those fixatives containing picric acid and potassium dichromate could be measured by color changes. Methylene blue was added to the colorless fixatives to obtain the same result. Pieces of the fixed areas were then dehydrated, infiltrated with paraffin, sectioned, and stained with Harris' hematoxylin and eosin by standard methods. Those preparations were studied carefully to evaluate the quality of fixation in regard to staining reaction and cellular preservation.

Results

Allen's fluid. The addition of the aliphatics did not appear to affect the speed of penetration of the fixatives, although the addition of Tergitol-4 gave the best fixation and staining qualities in brain tissue.

Helly's fluid. The addition of aliphatics resulted in a decrease in penetration and relatively marked changes in staining reactions. Although the addition of Tergitol-4 improved the staining qualities in liver, it was not as marked in brain. The quality of fixation was not noticeably changed in brain and varied slightly in liver. Tergitol-08 was comparable to Tergitol-4 in most respects, although the nuclear staining was poor.

Carnoy's fluid. There was only slight variation in penetration with the addition of the Tergitols. The fixation qualities were generally decreased, although Tergitol-08 with brain and Tergitol-4 with liver seemed to improve fixation.

Vandegrift's fluid. There was some variation in penetration with the Tergitols added. Thus, Tergitol-4 resulted in less penetration but improved fixation in brain, whereas Tergitol-7 gave equal penetration with improved fixation and less shrinkage. In liver, Tergitol-08 apparently gave maximum penetration; however, Tergitol-4 with decreased penetration showed better fixation.

Gilson's fluid. Penetration was generally improved in brain tissue with the addition of aliphatics. However, fixation was poorer because of the markedly increased shrinkage.

Zenker's fluid. In brain tissue, the addition of Tergitols -4 and -08 decreased penetration but improved fixation. In liver, Tergitols -7 and -08 decreased penetration of the fixatives but slightly improved the fixation and staining qualities of the tissue.

Formalin (10 per cent). The addition of the aliphatics, on the whole, resulted in little improveme However, Tergitol-4 added to the fixative improv fixation in both liver and brain.

Orth's fluid. The addition of the aliphatics i creased the penetration of the fixative, but usual resulted in poorer fixation and greater shrinkage. liver, the addition of Tergitol-4 improved fixation a staining.

Bouin's fluid. The penetration of the fixative w not affected by the addition of the aliphatics. The was little variation in fixation and only slight chang in the staining reactions of liver and brain.

There was no correlation between the various fix tives, their pH, component ingredients, or suppleme tal Tergitol, and the degree of penetration or th quality of fixation, staining, and shrinkage. How ever, we found that Tergitol-4, when added to Allen' Orth's, Vandegrift's, and Zenker's fluids and 10 p cent formalin, improved fixation and staining (Tab

TABLE 1

Results With Tergitol-4 Added to the Fixatives

Fixative	Tissue	Penetration	Fixation	Staining
Allen's	Liver	0	0	0
	Brain	0	+	+
Orth's	Liver	+	+	+
	Brain	+	0	0
Vandegrift's	Liver	−	+	+
	Brain	−	+	0
Zenker's	Liver	+	0	+
	Brain	−	+	+
10 per cent formalin	Liver	0	+	+
	Brain	0	+	0

TABLE 2

Results With Tergitol-08 Added to Zenker's

Tissue	Penetration	Fixation	Staining
Liver	−	+	+
Brain	−	+	+

(−) = decreased penetration; (0) = equal penetration, fix tion, and staining; (+) = increased penetration, improve fixation and staining.

1). Also, Tergitol-08, when added to Zenker's fluid improved fixation and staining (Table 2). All othe combinations of fixatives and detergents showed eithe no improvement or a decrease in the quality of fixa tion and staining.

References

1. Hance, R. T. *Proc. Pa. Acad. Sci.*, 1940, **14**, 114–116.
2. McClung, C. E. *Microscopical technique.* New York Paul B. Hoeber, 1937. P. 9.
3. Vandegrift, W. B. *Johns Hopk. Hosp. Bull.*, 194 **71**, 98–111.
4. Wilkes, B. G., and Wickert, J. N. *Ind. eng. Chem.* 1937, **29**, 1234.

Letters to the Editor

Relative to the B.S. Degree

After a careful reading of the article entitled "Need for a meaningful B.S. degree" (*Science*, 1946, **103**, 438), I fail to find any references to the A.B. degree, which is far the more common in the colleges. It has been my experience in placing men in graduate positions over a long period of years that graduate schools give preference to A.B. graduates over those who hold the other degree, mainly because the A.B. degree stands for a larger amount of preparation.

In our own institution, which I believe is typical of most others in its class, requirements for the A.B. in Physics include a major of 25 to 35 hours in that subject, 20 to 25 hours in Mathematics, and 10 to 20 hours in Chemistry. The requirements for a Chemistry major are similar, with the emphasis on that subject.

The trend of the discussion in the article mentioned above seems to imply that those who are employing scientists prefer the B.S. degree. Is that a fair statement of the case?

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The Metric System and the Historical Record

Discussion of the history of weights and measures in "Scanning Science" (*Science*, 1946, **103**, 446) and subsequent comment by Arthur Bessey Smith (*Science*, 1946, 103, 634) invite elaboration.

Duplicates of the standard meter and kilogram, now in the custody of the National Bureau of Standards, were brought to this country late in 1889 and on 2 January 1890 President Harrison officially received and opened these prototypes, allotted to the United States as national standards of weight and length. Although that event created considerable interest in scientific circles and induced widespread notice by the daily press, apparently the general public gave no more than passing attention to the advantages of metric units of weight and measure.

Earlier, in 1866, as Arthur Bessey Smith points out, Congress sanctioned use of the metric system and indicated its relation to the system customarily employed. As the result of legislation in that year, no contract or dealing, or pleading in any court, could be deemed invalid on account of reference to metric weights and measures. No metric standards were established, however.

A proposal to legally define the customary units of weight and measure in terms of the metric standards in possession of the National Bureau of Standards was contained in bills introduced by Representative A. R. Somers (H. R. 8974) and the later Senator Royal S. Copeland (S. 3609) in the 75th Congress, second session, 1938. Similar bills had been introduced by the same sponsors in the first session of the same Congress as H. R. 7869 and S. 2789. The import of the proposal may be ascertained from the following excerpt from testimony by Lyman J. Briggs, director of the National Bureau of Standards, at the hearings on H. R. 7869: "By defining the inch and the pound as certain specified fractions of the meter and kilogram, we base our customary system of weights and measures on material standards that have been shown to be highly stable and constant in value. But in doing so we do not for a moment relinquish the units of our customary system of weights and measures. On the contrary, for the first time in the history of our country their values will be definitely established by this legislation."

From time to time use of the metric units of weight and measure has been seriously urged by various groups and members of Congress. One bill to that end (H. R. 10, 69th Congress, first session, 1926) was subjected to extended study, and the hearings were published. This particular bill provided for the use of metric units in merchandising transactions only and allowed businessmen a period of 10 years to make necessary adjustments. A somewhat different objective is exemplified by H. R. 12580, 66th Congress, second session, which was designed to decimalize the customary units though not to replace them by the metric.

The metric system has figured incidentally in occasional legislation to establish standards for special uses. A Federal enactment in 1893, for example, established "the only standard gage for sheet and plate iron and steel in the United States of America." For each number of gage, tables specified the approximate thickness (in inches and millimeters), weight per square foot (in ounces, pounds, and kilograms), and weight per square meter (in pounds and kilograms). The Secretary of the Treasury was required to prepare suitable standards in accordance with this law.

The charge in "Scanning Science" (*Science*, 1946, 103, 446) that Congress has left practically unexercised the power of fixing the standard of weights and measures, granted by the Constitution (and previously by the Articles of Confederation), is perhaps a little too strong, even in reference to the metric units. Review of the pertinent literature discloses that several economically important Federal statutes have been passed under the power referred to, and others under the interstate commerce clause of the Constitution. Federal statutes, standards, or orders relate to a varied list of items which includes barrels and baskets, bills of lading, coins, cosmetics, drugs, electrical measure, foods, metals, packers and stockyards, precious stones, proof spirits, and screw threads.

A present problem more urgent than further Federal legislation is that of achieving greater uniformity in the State laws pertaining to bread, coal, packages of merchandise, weighing and measuring devices, and other commodities or articles of direct concern to the public.

Much of the educational leadership in connection with this problem has been borne by Lyman J. Briggs, Ralph W. Smith, and the late F. S. Holbrook, of the National Bureau of Standards. A Model State Law on Weights and Measures, recommended by both the National Council on Weights and Measures and the National Bureau of Standards, is recognized as the most satisfactory basis for developing sound State or local regulation.

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A Dangerous Postwar Development in Science Teaching

Is the teaching of first-year science courses in the colleges and universities of the South to be taken away from the science departments of these institutions? This alarming possibility is proposed in a bulletin, entitled "Studies of higher education in the South," put out by no less an authority than the Committee on Work Conferences of the Southern Association of Colleges and Secondary Schools and currently being circulated for approval by the institutions concerned. The proposal in question is found in Chapter IV, which deals with the teaching of first-year courses in the natural sciences in the postwar era. The following specific proposal is made: "It is further proposed that college and university departments as presently constituted not have control over either methods, subject matter content, or objectives in this phase of general education" (p. 43).

It is significant of present-day trends in higher education to note that no representative of the natural sciences was on the committee which drew up Bulletins VI and VII, Seventh Series, 1946. The opening paragraph of Chapter IV asserts that educators have assigned the natural sciences a place of peerage with the humanities and the social sciences. If the group which prepared this report believes this statement, why were not the natural sciences given some representation on the committee?

There are a number of other disturbing statements made in this bulletin concerning the teaching of science in institutions of higher learning in the South. This note is written to call attention to the fact that the teaching of science is definitely on trial in these postwar days, and that now is the time for scientists to express their criticisms of the unique document under consideration by writing to Dr. Roscoe E. Parker, Executive Secretary, Committee on Work Conferences, Southern Association of Colleges and Secondary Schools, University of Tennessee, Knoxville, Tennessee, prior to the summer meeting of the committee.

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Death-rate Study on a High Molecular Quaternary Ammonium Compound With *Bacillus metiens*

The few reports appearing in the literature on the germicidal activity of high molecular quaternary ammonium salts against spores indicate a very low order of activity for these compounds, especially when compared with their efficacy against vegetative cells. For instance, alkyl dimethyl benzyl ammonium chloride has been shown to kill spores of *Clostridium tetani* in 20 but not 10 minutes at a concentration of 1: 100 at 20°; of *Bacillus anthracis* in 15 minutes at a 1: 10 dilution; and of *Bacillus subtilis* in less than 30 minutes at a 1: 10 dilution at 37° at pH 8.6 or greater. There are numerous reports to indicate that dilutions of the order of 1: 500 of this compound are not effective against spores. The killing action of alkyl dimethyl benzyl ammonium chloride against spores is enhanced at higher temperatures.

As part of a program of study on the rate of action of high molecular quaternary ammonium compounds against bacteria, preliminary experiments were run against *B. metiens* following the procedure described by Weber and Levine (*J. Amer. publ. Hlth*, 1944, **34**, 719). The suspension of *B. metiens* in distilled water was heated to 80° C. for 10 minutes to kill vegetative cells, and 1 ml. was added to 99 ml. of the proper dilution of the compound to be tested. The solution was stirred throughout the period of test and samples plated at various time intervals. The germicide used was alkyl dimethyl 3,4-dichloro benzyl ammonium chloride (Tetrosan), and the tests were made at 20° at pH 7.

A 1: 10 dilution of Tetrosan was found necessary to kill *B. metiens* at 20° when tested by the FDA method. The killing dilution of Tetrosan against spores by the FDA method is of the same order as that of alkyl dimethyl benzyl ammonium chloride. A comparison of this killing dilution with the data on death-rate studies emphasizes the striking percentage reduction in the number of spores obtained with dilutions as low as 1: 5,000 and 1: 20,000. These high dilutions seem to kill a large number of spores (60–75 per cent) almost immediately, with a subsequent marked reduction in the rate of killing. Even after six hours only about 90 per cent of the organisms are killed. These results provide an indication that the FDA method does not give a complete picture of the germicidal action of a compound.

It is difficult to reconcile the data obtained with the concept of a logarithmic order of death. Actually, the experiments seem to demonstrate that the original population is made up of spores of very different resistance and that the death-rate pattern is due to the individual resistance.

The results of preliminary experiments, using the same technique with Tetrosan and cetyl trimethyl ammonium bromide, against *Staphylococcus aureus* parallel those obtained with spores. Whereas the killing dilution of these compounds against *Staph. aureus* is of the order of 1: 50,000, when determined by the FDA method, death-rate studies indicate that over 90 per cent of the organisms are killed immediately by dilutions as low as 1: 300,000. These experiments are being extended and will be published in a more detailed form at a later date.

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pergillus or What?

We have before us (*Science*, 1946, **103**, 116) G. W. artin's reproofs concerning our use of the generic name *spergillus*. We are quite familiar with the history of e names used for this group of molds. We are likewise ite aware that neither Wiggers in 1780 nor Link in 809 knew that the perithecia they were using to describe *ucor herbariorum* and *Eurotium herbariorum*, respectively, were developed on the same mycelium as the old *spergillus* which Micheli studied in his herbarium specimens. It is equally certain that Fries never bothered study this subject—he left it just as Link did. By e time DeBary (1854) showed that the perithecia of *urotium* developed from the same mycelium as the onidial heads of *Aspergillus*, the number of species involved was considerable, and naturally only a few accepted the fantastic transfer of such strictly conidial forms as *Aspergillus niger* and *Aspergillus flavus*, which re cosmopolitan, to *Eurotium Aspergillus niger* and *Eurotium Aspergillus flavus!* If the ascosporic forms were the only Aspergilli at stake, the advocation of a strict interpretation of the letter of the arbitrary rule relating to the nomenclatorial precedence of the perfect stage might be tolerated.

Nothing is lost to taxonomy if, instead of abandoning nearly 100 years of study of the Aspergilli before *Eurotium* was concocted, we simply amend Micheli's description to show that here and there among this multitude of species and strains a few groups actually produce ascospores. No one who has examined as many herbarium specimens as we have in our search of the beginnings of the study of the Aspergilli can fail to grasp the idea that we have merely completed Micheli's diagnosis of his genus. We doubt if any worker has examined the treatment of these molds by Micheli, Wiggers, Persoon, Link, Fries, DeBary, and more recent workers any more closely than we have. We equally doubt if any other mycologists have examined half the number of strains of *Aspergillus* in laboratory culture, or from natural sources, that have been handled by us. We are convinced that more nomenclatorial stability is to be attained by adding recognization of ascus formation in sections of Micheli's genus *Aspergillus* than could be reached by perpetuating the mistakes of Link and the negligence of Fries.

We do not defer to any man in our loyalty to the ideal of stable nomenclature, but with a background of years of experience and the examination of thousands of natural specimens and pure cultures, we stand by the conclusion that the general use of *Eurotium, Sterigmatocystis, Diplostephanus, Emericella*, etc. would only add confusion and difficulty without serving any constructive purpose. Why should the worker have to deal with multiple genera when a single one, and the oldest, will suffice? International recognition of *Aspergillus* for both ascosporic and conidial forms would constitute the logical and, we feel, correct solution.

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Book Reviews

Chromosome atlas of cultivated plants. C. D. Darlington and E. K. Janaki Ammal. London: Allen and Unwin, 1946. Pp. 397. $2.75.

The major portion of this volume is devoted to a catalogue of the chromosome numbers of some 10,000 species of cultivated plants—a work which should prove of inestimable value to investigators in many fields of the plant sciences. It is the most comprehensive contribution of its kind to have appeared since Gaiser's compilation in 1930 and brings well up to date the results of several hundred investigators throughout the world. By applying the term "cultivated" in a liberal sense the authors have included not only crop plants, drug plants, and ornamentals but also such groups as parasites, carnivorous plants, stocks used for fruit and flowering trees, latex plants, plants used for tools, weapons, etc., as well as those which furnish cork, herbicides, resins, and the like.

The families, genera, and species are arranged in systematic order according to the Bentham and Hooker system, which has the advantage of bringing together groups with related chromosome ratios. Beside each species is given its common name (when it has one), its somatic chromosome count, a reference to the literature, a symbol indicative of the use of the plant, and a statement of its geographic origin.

An introductory section contains a stimulating discussion of the origin of cultivated plants based in part upon the work of Vavilov and in part upon conclusions to which the authors' work has led them. Emphasis is placed on the fact that the center of diversity of many crop plants has shifted and that in many cases there has been not one region of hybridization and selection but several. The "snowball" effect of migration on variety is discussed, and some of the guiding principles of plant breeding, as determined by chromosome behavior, are elucidated.

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Die Methoden der Fermentforschung. (Vols. I–IV.) Eugen Bamann and Karl Myrbäck. New York: Academic Press, 1945. Pp. xx + 3388. (Illustrated.) $65.00.

Until one really digs into this set of volumes he cannot truly appreciate the tremendous task which the authors undertook and accomplished. The only word which can adequately describe the work is "encyclopedic." It is encyclopedic in the sense that it covers every field that in any way pertains to research in enzyme chemistry. One almost feels, while perusing the volumes, that they were written from the viewpoint of making them the only books necessary on the shelf of the enzyme chemist.

These volumes are photo-offset reproductions of the originals, published and distributed by authority of the Alien Property Custodian. The paper and bindings are excellent. The work is essentially European in origin, the various sections (all written by authorities in their respective fields) coming largely from western Europe. A small proportion was written by English authors, with less than 3 per cent emanating from the United States. It is unfortunate for those who might have wished to purchase certain volumes separately not only that the breaks between volumes come at illogical points, but that all of the literature references and indexes are collected together in Volume IV, thus making this volume essential to the value of all of the others.

Volume I begins with a short introduction, in which the definitions, nomenclature, and classification of enzymes are discussed. Approximately 400 pages are then devoted to the chemistry of the substrates, intermediates, and end products of enzyme actions. Each section of this portion discusses the synthesis (where possible), isolation from natural sources, some of the chemical reactions, and, finally, certain of the physical properties of the substances in question. These substances range from glycerides, starch, cellulose, and proteins to nucleic acids, tannins, chlorophyll, acetylcholine, and acceptor dyes. While the chemistry is not as complete as one would find in monographs, it gives a very satisfactory background to the nonspecialist. Six pages, for instance, are devoted to a discussion of the structural chemistry of the proteins.

The next phase of the subject to be taken up is that of methods—largely those of a physicochemical nature. Nearly 60 pages are devoted to a discussion of the use of X-rays in the determination of the structure of organic substances. There follows a series of sections devoted, among other subjects, to absorption spectra, Raman spectra, fluorescence, polarography, dielectric constants, ultracentrifugation, diffusion, sublimation, and the determinations of melting points and molecular weights. These chapters are not in the least superficial. They delve into the underlying physical principles and develop the fundamental mathematical equations where such are germane to the subject.

The second section of Volume I goes into the subject of catalysis and reaction rates, with discussions of all of the various means of measuring the latter, including polarimetry, refractometry, spectroscopy, and the use of the interferometer. Theories of buffers, pH, and redox potentials are developed. These even go into such detail as to describe, with illustrations, how to platinize an electrode. Finally, there is a lengthy discussion of the free energy of reactions, and several sections devoted to the microanalytical procedures used for the quantitative assay of many of the participants in enzyme reactions.

Volume II is devoted largely to the preparation, isolation, and characterization of enzymes and includes sections on the preparation of enzymes from bacteria, algae, yeasts, molds, and protozoa, as well as from more conventional animal and plant materials. The major por-

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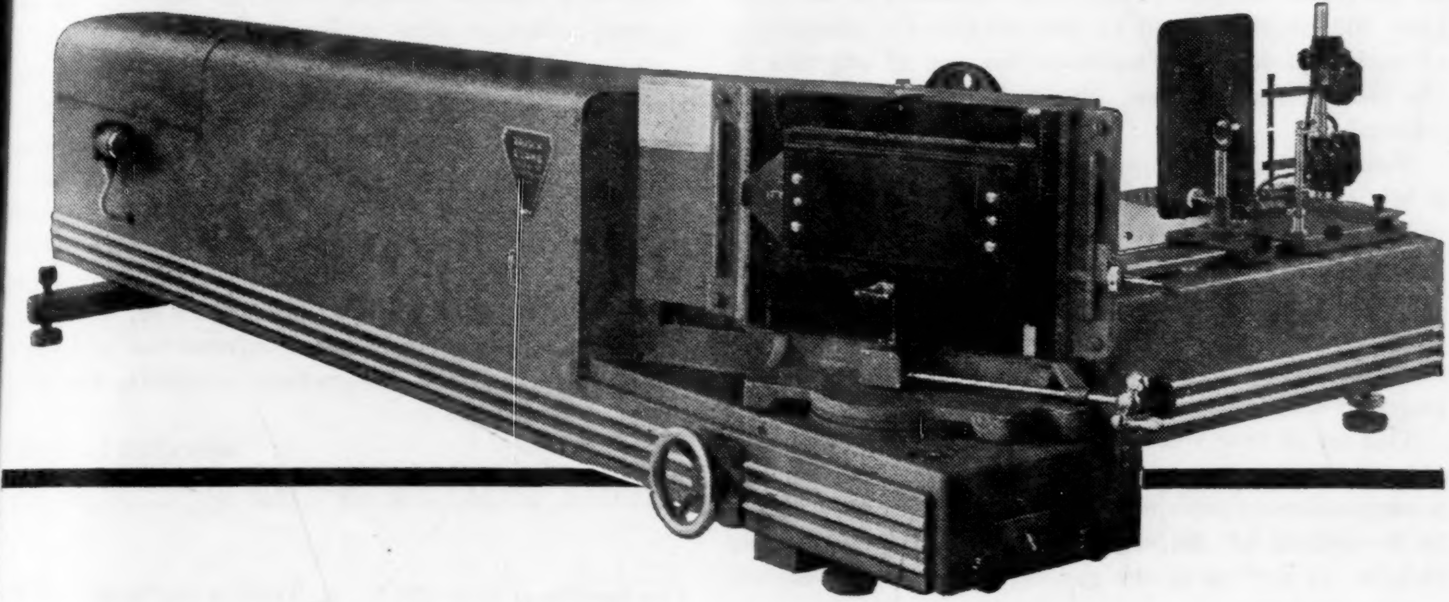

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tion of the volume is devoted to the hydrolases (carbohydrases, nucleases, and amidases). This section continues on into Volume III, without a break, to take up the proteases and "thrombase" (including a discussion of blood coagulation).

Volume III then goes on with the desmolases, including a lengthy discussion of alcoholic fermentation. Following this are found chapters on a wide variety of enzymes which participate in oxidation-reduction reactions, including such typical representatives as the cytochromes, peroxidase, catalase, and hydrogenase.

The latter part of Volume III is devoted to lengthy sections on assimilation in plants and bacteria, antienzymes, model enzymes, the place of enzymes in medical chemistry (including cancer), and finally, a large section on the industrial uses of enzymes. Included in the more than 200 pages devoted to this subject are discussions of such representative topics as the use of enzymes in the baking, fermentation, fat, milk, and pharmaceutical industries.

Volume IV, as mentioned above, is largely made up of a bibliography of over 6,000 references, some of them referring to early 1940 literature. The inclusion of many references under subnumbers, obviously added at a later date, indicates the effort of the authors to make these volumes completely up to date. Included also are complete author and subject indexes and, finally, three pages of corrections.

This set of four volumes represents an extremely valuable addition to the chemical literature. It is essentially a compendium of information, no effort having been made to be critical of the cited literature. To the enzyme chemist, as well as to the general biochemist, it is well worth possession.

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A textbook of bacteriology and immunology. **Joseph M. Dougherty and Anthony J. Lamberti. St. Louis: C. V. Mosby, 1946. Pp. 360. (Illustrated.)**

This small, attractively bound book is described in the Preface as an effort "to simplify the various phases of bacteriology and immunology, for the purpose of securing the interest and enthusiasm of the average student." The guiding philosophy is stated as "the resolution of all difficulties from the viewpoint of the student." Bacteriology and immunology are covered in only 313 pages; a section of 31 pages on parasitic protozoa follows. The text is written in a clear, straightforward style, and there are especially helpful chapters on the microscope, quantitative titrations, and the blood. Otherwise, the book generally follows outlines that are traditional.

Unfortunately, a considerable amount of the limited textual material is given over to technical directions for laboratory work, and still more space is devoted to descriptions of the older rather than of the newer concepts of microbiology. Attention to historical matters, and omission of much relatively new information, is especially noticeable in the chapters on the pathogenic micro-organisms and on immunity. For example, no mention is made of active immunization against tetanus. In the immunology section the diagrams showing Ehrlich's side-chain theory, which were so conspicuous a feature of early treatises on immunity, are reproduced. The reviewer had never again expected to see these pictures in a modern textbook or to find the inaccurate ideas prevailing in the infancy of immunology again set forth in detail. At the same time, the basic physicochemical phenomena now recognized as actually responsible for in *vitro* antigen-antibody reactions are not clearly described. The fundamental subject of hypersensitivity is not discussed at all, and although there are separate chapters on filtrable viruses and on rickettsiae, nothing is said about such common virus infections as measles, influenza, or encephalitis, or about endemic (flea-borne) typhus.

The reviewer is in sympathy with the commendable aims of the authors to present a brief text that promotes the cultural values inherent in the study of bacteriology and that simplifies matters so that the average student can easily comprehend them. This book, however, omits so much of the newer, significant knowledge that it leaves the reader with an inadequate understanding of various phases of up-to-date microbiology. Even so, it does succeed in condensing much useful information and doubtless will appeal to undergraduate students, for whom it was designed.

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The Svedberg, 1884–1944. **A. Tiselius and Kai O. Pedersen. (Eds.) Uppsala, Sweden: Almqvist and Wiksells, 1945. Pp. 731.**

This is a contribution to commemorate the 60th birthday of the distinguished Swedish scientist, The Svedberg. There are 55 chapters or papers (mainly in the field of chemistry and chemical engineering) by 70 authors: 37 papers are in English, 11 in German, 5 in Swedish, and 2 in French. Because this volume was projected and prepared during the war years when free communications with colleagues in other lands were difficult, if not impossible, all but two of the authors are Swedes, although Dr. Svedberg's great contributions to chemistry and to chemical industry are known the world over. Some of the chapters give us glimpses of Dr. Svedberg's challenging life and extraordinary labors and achievements. Hardly anything makes Dr. Svedberg as happy as "planting a young seedling and watching it grow."

This volume, published by the aid of 21 Swedish industrial organizations in honor of an outstanding scientist in the field of chemistry and chemical engineering, is a reminder that the size of a country is no measure of the caliber of that country's citizens, be they scientists or statesmen.

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